

Appendix A: Planning

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A.1 General Guidelines

A.1.1 What is a Construction Stormwater Pollution Prevention Plan?

The Construction SWPPP is a document that describes the potential for pollution problems on a construction project. The Construction SWPPP explains and illustrates the measures to be taken on the construction site to control those problems. A Construction SWPPP for projects that adds, clears, or replaces impervious surface must have a narrative as well as drawings and details. The local permitting authority must review these Construction SWPPPs. The local permitting authority may allow single-family home construction projects to prepare a simpler Construction SWPPP, consisting of a checklist and a plot plan.

While it is a good idea to include standards and specifications from the Construction SWPPP in the contract documents, the Construction SWPPP should be a separate document that can stand alone. The Construction SWPPP must be located on the construction site, or within reasonable access to the site, or at another approved location as defined by either ADEQ or the local municipality for construction and inspection personnel; although, a copy of the drawings must be kept on the construction site at all times.

As site work progresses, the plan must be modified to reflect changing site conditions, and is subject to the rules for plan modification by the local permitting authority.

The owner or lessee of the land being developed has the responsibility for Construction SWPPP preparation and submission to local authorities. The owner or lessee may designate someone (i.e., an engineer, architect, contractor, etc.) to prepare the Construction SWPPP, but he/she retains the ultimate responsibility.

A.1.2 What is an Adequate Plan?

An adequate Construction SWPPP includes a narrative and drawings. The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information about existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

On construction sites that discharge to a surface water body, the primary concern in the preparation of the Construction SWPPP is compliance with ADEQ regulations. A step-by-step procedure is recommended for the development of the Construction SWPPPs. The checklists in Appendix G may be helpful in preparing and reviewing the Construction SWPPP.

On construction sites that infiltrate all stormwater runoff, the primary concern in the preparation of the Construction SWPPP is the protection of the infiltration facilities from fine sediments during the construction phase and protection of ground water from other pollutants. Several of the other elements are very important at these sites as well, such as marking the clearing limits, establishing the construction access, and managing the project.

A.1.3 General Principles

The following general principles should be applied to the development of the Construction SWPPP.

- The duff layer, native topsoil, and natural vegetation should be retained in an undisturbed state to the maximum extent practicable.
- Prevent pollutant release. Select source control BMPs as a first line of defense. Prevent erosion rather than treat turbid runoff.
- Select BMPs depending on site characteristics (topography, drainage, soil type, ground cover, and critical areas) and the construction plan.
- Divert runoff away from exposed areas wherever possible. Keep clean water clean. Limit the extent of clearing operations and phase construction operations.
- Before re-seeding a disturbed soil area, amend all soils with compost wherever topsoil has been removed.
- Incorporate natural drainage features whenever possible, using adequate buffers and protecting areas where flow enters the drainage system.
- Minimize slope length and steepness.
- Reduce runoff velocities to prevent channel erosion.
- Prevent the tracking of sediment off-site.
- Select appropriate BMPs for the control of pollutants other than sediment.
- Be realistic about the limitations of controls that you specify and the operation and maintenance of those controls. Anticipate what can go wrong; how you can prevent it from happening; and what will need to be done to fix it.

A.2 Step-By-Step Procedure

A.2.1 Data Collection and Analysis

Consider the data collected to visualize the potential problems and limitations of the site. Determine which areas may have critical erosion hazards. The below factors should be considered in data analysis. Also evaluate existing site conditions and gather information that will help develop the most effective Construction SWPPP. The information gathered should be explained in the narrative and shown on the drawings.

Topography: Prepare a topographic drawing of the site to show the existing contour elevations at intervals of 12" to 5'-0" depending upon the slope of the terrain. The primary considerations are the slope steepness and length. The effect of runoff has a greater erosion potential with longer and steeper slopes. Erosion potential should be determined by a qualified engineer, soil professional or certified erosion control specialist.

Drainage: - Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drain pipe systems. Natural drainage patterns that consist of overland flow, swales, and depressions should be used to convey runoff through the site to avoid constructing an artificial drainage system. Man-made ditches and waterways will become part of the erosion problem if they are not properly stabilized. Care should be taken to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Possible sites for temporary stormwater retention and detention should be considered. Construction should be directed away from areas of saturated soil - areas where groundwater may be encountered - and critical areas where drainage will concentrate. Preserve the natural drainage patterns on-site as much as possible.

Soils: Identify and label soil type(s) and erodibility (low, medium, high or an index value from the NRCS manual) on the drawing. Soils information can be obtained from a soil survey if one has been published for the county. If a soil survey is not available, a request can be made to a district Natural Resource Conservation Service Office.

Soils must be characterized for permeability, % organic matter, and effective depth by a qualified soil professional or engineer. These qualities should be expressed in averaged or nominal terms for the subject site or project. This information is frequently available in published literature. For example, the 1983 Soil Survey of Snohomish County lists the following information for each soil mapping unit or designation (e.g., a Sultan silt loam):

- a sieve analysis of the soils
- permeability (in/hr)
- available water-holding capacity (in/in)
- the percent of organic matter

Ground Cover: Label existing vegetation on the drawing. Such features as tree clusters, grassy areas, and unique or sensitive vegetation should be shown. Unique vegetation may include existing trees above a given diameter. Local requirements regarding tree preservation should be investigated. In addition, existing denuded or exposed soil areas should be indicated.

Ground cover is the most important factor in terms of preventing erosion. Existing vegetation that can be saved will prevent erosion better than any constructed BMP. Trees and other vegetation protect the soil structure. If the existing soil can NOT be saved, consider phasing construction, temporary seeding, and/or mulching.

Critical Areas: Delineate critical areas adjacent to or within the site on the drawing. Such features as steep slopes, streams, floodplains, lakes, wetlands, sole source aquifers, and geologic hazard areas, etc., should be shown. Delineate setbacks and buffer limits for these features on the drawings. Other related jurisdictional boundaries such as the Federal Emergency Management Agency (FEMA) base floodplain should also be shown on the drawings.

Other critical areas include (but are not limited to) flood hazard areas, mine hazard areas, slide hazard areas, sole source aquifers, wetlands, stream banks, fish-bearing streams, and other surface water bodies. Any critical areas within or adjacent to the development should exert a strong influence on the land development decisions. Critical areas and their buffers shall be delineated on the drawings and clearly marked in the field. Chain-link or other types of fencing may be more useful than just flagging the area(s) to ensure that equipment operators stay out of the critical areas. Only unavoidable work should occur within critical areas and their buffers. Unavoidable work will require special BMPs, permit restrictions, and mitigation plans.

Adjacent Areas: Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits and erosion and sediment control BMPs on the drawings. An analysis of adjacent properties should focus on areas upslope AND downslope from the construction project. Water bodies that will receive direct runoff from the site are a major concern. The types, values, and sensitivities of and risks of downstream resources such as private property, stormwater facilities, public infrastructure, or aquatic systems should be evaluated. Erosion and Sediment controls should be selected accordingly.

Existing Encumbrances: Identify wells, existing and abandoned septic drain field, utilities, and site constraints.

Precipitation Records: Determine the average monthly rainfall and rainfall intensity for the required design storm events. Make sure the on-site rain gauge is read for the precipitation after every rainfall event to compose the required rainfall records and verify the method of analysis for the design of the site BMPs.

A.2.2 Construction SWPPP Development and Implementation

After collecting and analyzing the data to determine the site limitations, the planner can then develop a Construction SWPPP. Each of the elements below must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP.

Element #1: Mark Clearing Limits

Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts. Plastic, metal, or stake wire fence may be used to mark the clearing limits.

Element #2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route, if possible; or two for linear projects such as roadways where more than one access is necessary for large equipment maneuvering. Access points shall be stabilized with a pad of quarry spalls or crushed rock prior to

traffic leaving the construction site to minimize the tracking of sediment onto public roads.

- Wheel wash or tire baths should be located on-site, if applicable.
- If sediment is tracked off-site, public roads shall be -at a minimum - cleaned thoroughly at the end of each day, or more frequently if necessary to prevent sediment from entering Waters of the State. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only AFTER sediment is removed in this manner.
- Street wash water shall be controlled by pumping back on site or otherwise be prevented from discharging into systems tributary to state surface waters.

Element #3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- Downstream analysis is necessary if changes in off-site flows could impair or alter conveyance systems, stream banks, bed sediment, or aquatic habitat. See Chapter 3 for off-site analysis guidelines.
- Where curb inlet protection is necessary, stormwater retention/detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces).
- The local permitting agency may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

Element #4: Install Sediment Controls

- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3 above. Full stabilization means concrete or asphalt paving; coarse rock or native stone used as ditch lining; the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The municipality shall inspect and approve areas fully stabilized by means other than pavement.
- Sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5 below.

Element #5: Stabilize Soils

- All exposed and un-worked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact, flowing water, and wind.
- Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Applicable practices include, but are not limited to, temporary and permanent seeding; sodding; mulching; erosion control fabrics and matting; soil application of PAM; the early application of gravel base on areas to be paved; and dust control.
- Soil stabilization measures should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and when possible, be located away from storm drain inlets, waterways and drainage channels.

- Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils.

Element #6: Protect Slopes

- Design and construct cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Off-site stormwater (run-on) shall be diverted away from slopes and disturbed areas with interceptor dikes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion. Temporary pipe slope drains shall handle the peak flow from a 10 year, 24-hour design storm event. Consult the local drainage requirements for sizing permanent pipe slope drains.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Check dams shall be placed at regular intervals within channels that are cut down a slope.

Element #7: Protect Drain Inlets

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- All approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to Waters of the State.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned, removed, and/or replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Element #8: Stabilize Channels and Outlets

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected peak 10-minute velocity of flow from a 10-year, 24-hour design storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches shall provide at the outlets of all conveyance systems.

Element #9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater.
- Maintenance and repair of heavy equipment and vehicles involving oil changes; hydraulic system drain down; solvent and de-greasing cleaning operations; fuel tank drain down and removal; and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer, if approved by that utility.
- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed

aggregate processes, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause or contribute to a violation of the water quality standard for pH in the receiving water.

- Construction sites with significant concrete work shall adjust the pH of stormwater if necessary to prevent violations of water quality standards.

Element #10: Control De-Watering

- Foundation, vault, and trench de-watering water, which have similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.
- Highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete pour, or work inside a cofferdam, shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, may include:
 1. infiltration;
 2. transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters;
 3. ADEQ approved on-site chemical treatment or other suitable treatment technologies;
 4. sanitary sewer discharge with local sewer district approval, if there is no other option; or
 5. use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Element #11: Maintain BMPs

- All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with BMP specifications.
- All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on-site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12: Manage the Project

- Phasing of Construction.

Development projects shall be phased where feasible in order to prevent soil erosion and, to the maximum extent practicable, the transport of sediment from the site during construction. Re-vegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance or compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

- Coordination with Utilities and Other Contractors

The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

- Inspection and Monitoring

All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. The person must have the skills to:

1. assess the site conditions and construction activities that could impact the quality of stormwater, and
2. assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

For construction sites 1 acre or larger that discharge stormwater to Waters of the State, a Certified Contractor's Site Official (CCSO - see BMP 140) shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be obtained through an approved training program that meets the erosion and sediment control training standards.

Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

- **Maintaining an Updated Construction SWPPP**

The Construction SWPPP shall be retained on-site or within reasonable access to the site. The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to Waters of the State.

The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.

The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

A.3 Construction SWPPP Requirements

The Construction SWPPP shall consist of two parts: a narrative and the drawings. The following two sections describe the contents of the narrative and the drawings. A checklist is included in Appendix G that can be used as a quick reference to determine if all the major items are included in the Construction SWPPP.

A.3.1 Narrative

- Describe the existing topography, vegetation, and drainage. Include a description of any structures or development on the parcel including the area of existing impervious surfaces.
- Describe adjacent areas, including streams, lakes, wetlands, residential areas, and roads that might be affected by the construction project. Provide a description of the downstream drainage leading from the site to the receiving body of water.
- Describe areas on or adjacent to the site that are classified as critical areas. Critical areas that receive runoff from the site shall be described up to ¼ mile away. The distance may be increased by the municipality. Describe special requirements for working near or within these areas.
- Describe areas on the site that have potential erosion problems.
- Describe the intended sequence and timing of construction activities any proposed construction phasing.
- Describe the construction schedule. If the schedule extends into the wet season, describe what activities will continue during the wet season and how the transport of sediment from the construction site to receiving waters will be prevented.
- Engineering calculations must bear the signature and stamp of an engineer licensed in the state of Arkansas.
- A responsible, certified erosion control specialist shall be identified. All telephone, fax, and/or pager numbers should be included along with email addresses.

A.3.2 Drawings

- Provide a map with enough detail to identify the location of the construction site; adjacent roads; and receiving waters.
- Provide a site map(s) showing the following features. The site map requirements may be met using multiple plan sheets for ease of legibility.

1. A legal description of the property boundaries or an illustration of property lines (including distances) in the drawings.
2. The direction of north in relation to the site.
3. Existing structures and roads, if present.
4. The boundaries of and label the different soil types.
5. Areas of potential erosion problems.
6. Any on-site and adjacent surface waters, critical areas, their buffers, FEMA base flood boundaries, and Shoreline Management boundaries.
7. Existing contours and drainage basins and the direction of flow for the different drainage areas.
8. Final and interim grade contours as appropriate, drainage basins, and the direction of stormwater flow during and upon completion of construction.
9. Areas of soil disturbance, including all areas affected by clearing, grading and excavation.
10. Locations where stormwater discharges to surface waters during and upon completion of construction.
11. Existing unique or valuable vegetation and the vegetation that is to be preserved.
12. Cut and fill slopes indicating top and bottom of slope catch lines.
13. Stockpile, waste storage, and vehicle storage/maintenance areas.
14. Total cut and fill quantities and the method of disposal for excess material
- Show on the site map the following temporary and permanent conveyance features:
 1. Locations for swales, interceptor trenches, or ditches.
 2. Drainage pipes, ditches, or cut-off trenches associated with erosion and sediment control and stormwater management.
 3. Temporary and permanent pipe inverts and minimum slopes and cover.
 4. Grades, dimensions, and direction of flow in all ditches and swales, culverts, and pipes.
 5. Details for bypassing off-site runoff around disturbed areas.
 6. Locations and outlets of any dewatering systems.
- Show on the site map the locations of stormwater detention BMPs.
- Show on the site map all major structural and nonstructural ESC BMPs including:
 1. The location of sediment pond(s), pipes and structures.
 2. Dimension pond berm widths and inside and outside pond slopes.
 3. The trap/pond storage required and the depth, length, and width dimensions.
 4. Typical section views through pond and outlet structure.
 5. Typical details of gravel cone and standpipe, and/or other filtering devices.
 6. Stabilization technique details for inlets and outlets
 7. Control/restrictor device location and details.
 8. Stabilization practices for berms, slopes, and disturbed areas.
 9. Rock specifications and detail for rock check dam, if used.
 10. Spacing for rock check dams as required.
 11. Front and side sections of typical rock check dams.
 12. The location, detail, and specification for silt fence.
 13. The construction entrance location and a detail.
- Indicate on the site map the water quality sampling locations, if required by the local, state, or federal permitting authority. Sampling stations shall be located in accordance with applicable permit requirements
- Standard notes are suggested in Appendix C.
- Notes addressing construction phasing and scheduling shall be included on the drawings.

Appendix B: Low-Impact Development

- B.1 Site & Design Considerations
 - B.1.1 Landscaping and Vegetative Control Practices
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- B.6 Undisturbed Water Body Buffer

B.1 Site & Design Considerations

B.1.1 Landscaping and Vegetative Control Practices

Landscaping and vegetative control practices can be applied to any land use type, but the following site-specific criteria should be considered to properly select a plant species or landscape options:

- Climate
- Topography
- Soil Types
- Wind exposure
- Soil drainage and moisture conditions
- Available light or shade tolerance
- Planned use of the area
- Degree of maintenance desired
- Planting season

Certain criteria may be targeted for landscaping and vegetative control practices for their added stabilization benefits or support of other BMPs. Targeted areas may include:

- Steep slopes
- Drainage channels with natural cover
- Streams and creeks
- Areas connected to catch basins
- Buffer zones
- Use in conjunction with various structural BMPs (i.e. detention/retention ponds, wetlands, swales, etc.)

B.1.2 Infiltration Techniques

Design is suitable for nearly all residential, commercial or industrial lots.

- Storage Practices
- Development density can be clustered to leave areas with soils that have high infiltration rates undisturbed.
- Where possible, disconnect rooftop downspouts from pervious surfaces to drain over vegetative filter strips.
- Cisterns and rain barrels have the fewest site constraints.
- Design and use should have some contingency for overflow or freezing.
- Best suited for applications with an interest in re-using the water.
- Pre-treatment usually requires a wire mesh filter at the top of the cistern or barrel.
- Infiltration
- Bio-retention and grassed swales are common infiltration techniques.
- Design and use should consider the peak flow demands, topography, and soil types.
- In areas where local soils do not readily support infiltration, sand filtration systems can be used to

discharge treated stormwater to a stream or storm sewer.

- Rain Gardens
- Rain gardens are landscaped bio-retention facilities that soak up runoff displaced by the impervious area of a structure. Runoff is trapped during a storm event, infiltrating slowly into the soil where it is treated by vegetation and microbes. Rain gardens can increase the aesthetic qualities of a development, and offer a greater benefit than traditional gardens. Rain gardens can have substantial environmental and water quality benefits.
- Infiltration requires layers of soil, sand and organic mulch. In areas where local soils do not readily support infiltration, rain gardens can be modified to be underlain with a sand filtration system and under drain that discharges treated stormwater to a storm sewer.
- Rain garden vegetation should include indigenous plants and can be integrated into current or future landscaping using grasses, ferns or flowering plants.
- Rain gardens should be at least 10'-0" away from a structure to prevent groundwater seepage into the foundation. Rain gardens should be built level into a gentle slope that drains runoff. Additionally, rain gardens preferably should not be placed in right-of-way.
- Do not place rain garden directly over septic systems. Build in areas of full or partial sun. For more information, visit <http://www.stormwatercenter.net>

B.1.3 Impervious Surface Area Reduction

Applying techniques to reduce the impervious surface area of new development and re-development is often dependent on the applicability, cost, and maintenance of those techniques. Alternative roadway layouts and reduction of parking spaces should be considered to reduce overall imperviousness. Green Parking techniques reduce the impervious area of parking lots and consequently, the amount of stormwater runoff. Likewise, Green Rooftop reduces the impervious area of rooftops and consequently, the amount of stormwater runoff.

Green Parking techniques include:

- Shared parking in mixed use areas and structured parking.
- Building additional parking upwards or downwards (i.e. parking garages). Design around average parking demands instead of conventional parking requirements. Provide an overflow lot utilizing grass or alternative pavers for peak demand parking. For more on alternatives, visit <http://www.stormwatercenter.net>
- Minimizing parking space dimensions by reducing the length and width of spaces.
- Parking areas restricted to compact cars.
- Incorporate bio-retention areas in parking lot design to effectively treat stormwater runoff.

Green Rooftop is a layer of vegetation, shrubs, or trees planted on rooftops to absorb stormwater runoff.

In the summer, Green Rooftops retain approximately 70% to 100% of the precipitation that falls on them. In the winter, they retain approximately 40% to 50%. A green rooftop generally consists of:

- A waterproofing membrane
- Insulation
- Protection layer
- Drainage layer
- Filter mat
- Soil layer
- Vegetation
- The load-bearing capacity of the rooftop should be identified prior to green rooftop design. It is recommended to consult a structural engineer before designing or installing a green rooftop. If the projected live load of a green rooftop is greater than 17 lbs per square foot, consultation with a structural engineer is required
- An internal drainage network that directs flow away from the roof to inhibit ponding should be included in the design.
- Green rooftops can be successfully built on slopes up to 30 degrees.
- Other things pervious surfaces can do:

- Filter pollutants from stormwater runoff or groundwater.
- Recycle carbon dioxide into oxygen.
- Provide shade along waterways and sustain the integrity of stream ecosystems and habitats.

Forestry is commonly used as an aquatic buffer. The benefits of buffers are increased in a forested condition.

B.2 Costs

Low-impact development costs vary depending on the application, area, and land use. A few general guidelines used to estimate costs are listed below.

- Approximately \$100 for a rain barrel and up to \$200 for a dry well.
- Infiltration areas cost about \$6.40 per cubic foot of quality treatment.
- Initial costs of a green roof can be 30% greater than a conventional roof. However, long-term maintenance and energy costs savings can offset initial costs and increase the lifespan by as much as 50%. Green rooftops can be warranted up to 15 years.

B.3 Maintenance Landscaping and Vegetative Control Practices

- Irrigation, fertilization, and mulching are variable maintenance practices dependant on the plant species, soil conditions, and topography.
- Established vegetation and landscaping may need periodic seasonal trimming to maintain aesthetic appearance.
- Mow or weed as necessary.

B.4 Infiltration Techniques

- Practices require frequent, but small efforts to maintain, such as draining a rain barrel after a large wet weather event; cleaning debris out of the infiltration practices; or keeping the vegetation in the rain garden from overgrowing. Weeding and watering will be needed in the first 2 years of establishing a rain garden, and thinning of plants in the following years as they mature.
- Maintenance is dependent on the owner's efforts. Can be maintained by commercial landscaping firms.

B.5 Impervious Surface Area Reduction

- Alternative pavers generally have a moderate cost of maintenance associated with them and snow removal can be difficult.
- Clear debris or blockage from internal drainage network to prevent overflow and ponding on green roofs.
- Established vegetation on green roofs may need periodic seasonal trimming to maintain aesthetic appearance.

B.6 Undisturbed Water Body Buffer

- Established vegetation, shrubs and trees may need periodic seasonal trimming or pruning to maintain aesthetic appearance.

Appendix C: Standard Comments

The following standard notes are suggested for use in erosion control plans. Local jurisdictions may have other mandatory notes for construction plans that are applicable. Plans should identify with phone numbers the person or firm responsible for the preparation of and maintenance of the erosion control plan.

Standard Notes

- Approval of this ESC plan does not constitute an approval of permanent road or drainage design (e.g. size and location of roads, pipes, restrictors, channels, retention facilities, utilities, etc.).
- The implementation of the ESC plans and the construction, maintenance, replacement, and upgrading of the ESC facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established. The boundaries of the clearing limits shown on the plan shall be clearly flagged in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the applicant/contractor for the duration of construction.
- The ESC facilities shown on the plan must be constructed in conjunction with all clearing and grading activities, and in such a manner as to insure that sediment and sediment-laden water do not enter the drainage system, roadways, or violate applicable water standards.
- The ESC facilities shown on the plan are the minimum requirements for anticipated site conditions. During the construction period, the ESC facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
- The ESC facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.
- The ESC facilities on in-active sites shall be inspected and maintained a minimum of once a month and within 48 hours following any storm event.
- At no time shall more than 12" of sediment be allowed to accumulate. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment-laden water into the downstream system.
- Stabilized construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.

Appendix D: Information on Chemical Treatments

D.1 Chemical Treatments for Turbidity Reduction

D.1.1 Coagulation

D.1.2 Flocculation

D.1.3 Clarification

D.2 Coagulants

D.3 Application Considerations

D.4 Mixing in Coagulants & Flocculation

D.5 Polymer Batch Treatment

D.6 Adjustment of pH and Alkalinity

D.1 Chemical Treatment for Turbidity Reduction

Coagulation and flocculation have been used for over a century to treat water. It is used less frequently for the treatment of wastewater. The use of coagulation and flocculation for treating stormwater is a very recent application. Experience with the treatment of water and wastewater has resulted in a basic understanding of the process, in particular factors that affect performance. This experience can provide insights as to how to most effectively design and operate similar systems in the treatment of stormwater.

Fine particles suspended in water give it a milky appearance, measured as turbidity. Their small size, often much smaller than 1.00 μm in diameter, gives them a very large surface area relative to their volume. These fine particles typically carry a negative surface charge. Largely because of these two factors - small size and negative charge - these particles tend to stay in suspension for extended periods of time; thus, removal is not practical by gravity settling. These are called stable suspensions. Polymers, as well as inorganic chemicals such as alum, speed the process of clarification. The added chemical destabilizes the suspension and causes the smaller particles to agglomerate. The process consists of three steps: coagulation, flocculation, and settling or clarification. Each step is explained below as well as the factors that affect the efficiency of the process.

D.1.1 Coagulation:

Coagulation is the first step. It is the process by which negative charges on the fine particles that prevent their agglomeration are disrupted. Chemical addition is one method of destabilizing the suspension, and polymers are one class of chemicals that are generally effective. Chemicals that are used for this purpose are called coagulants. Coagulation is complete when the suspension is destabilized by the neutralization of the negative charges.

Coagulants perform best when they are thoroughly and evenly dispersed under relatively intense mixing. This rapid mixing involves adding the coagulant in a manner that promotes rapid dispersion, followed by a short time period for destabilization of the particle suspension. The particles are still very small and are not readily separated by clarification until flocculation occurs.

D.1.2 Flocculation:

Flocculation is the process by which fine particles that have been destabilized bind together to form larger particles that settle rapidly. Flocculation begins naturally following coagulation, but is enhanced by gentle mixing of the destabilized suspension. Gentle mixing helps to bring particles in contact with one another such that they bind and continually grow to form "flocs." As the size of the floc increases they become heavier and tend to settle more rapidly.

D.1.3 Clarification:

The final step is the settling of the particles. Particle density, size and shape are important during settling. Dense, compact floc settles more readily than less dense, fluffy floc. Because of this, flocculation to form dense, compact floc is particularly important during water treatment. Water temperature is also important during settling. Both the density and viscosity of water are affected by temperature, which in turn affect settling.

Cold temperatures increase viscosity and density, thus slowing down the rate at which the particles settle.

The conditions under which clarification is achieved can affect performance. Currents can affect settling. Currents can be produced by wind; by differences between the temperature of the incoming water and the water in the clarifier; and by flow conditions near the inlets and outlets. Quiescent water such as that which occurs during batch clarification provides a good environment for effective performance as many of these factors become less important in comparison to typical sedimentation basins. One source of currents that is likely important in batch systems is movement of the water leaving the clarifier unit. Given that flocs are relatively small and light the exit velocity of the water must be as low as possible. Sediment on the bottom of the basin can be re-suspended and removed by fairly modest velocities.

D.2 Coagulants:

Polymers are large organic molecules that are made up of sub-units linked together in a chain-like structure.

Attached to these chain-like structures are other groups that carry positive or negative charges, or have no charge. Polymers that carry groups with positive charges are called cationic; those with negative charges are called anionic; and those with no charge (neutral) are called non-ionic.

Cationic polymers can be used as coagulants to destabilize negatively charged turbidity particles present in natural waters, wastewater and stormwater. Aluminum sulfate (alum) can also be used as this chemical becomes positively charged when dispersed in water. In practice, the only way to determine whether a polymer is effective for a specific application is to perform preliminary or on-site testing.

Polymers are available as powders, concentrated liquids, and emulsions (which appear as milky liquids). The latter are petroleum-based, which are not allowed for construction stormwater treatment. Polymer effectiveness can degrade with time and also from other influences. Thus, manufacturers' recommendations for storage should be followed. Manufacturer's recommendations usually do not provide assurance of water quality protection or safety to aquatic organisms. Consideration of water quality protection is necessary in the selection and use of all polymers.

D.3 Application Considerations:

Application of coagulants at the appropriate concentration or dosage rate for optimum turbidity removal is important for management of chemical cost, for effective performance, and to avoid aquatic toxicity. The optimum dose in a given application depends on several site-specific features. Turbidity of untreated water can be important with turbidities greater than 5,000 NTU. The surface charge of particles to be removed is also important. Environmental factors that can influence dosage rate are water temperature, pH, and the presence of constituents that consume or otherwise affect polymer effectiveness. Laboratory experiments indicate that mixing previously settled sediment (floc sludge) with the untreated stormwater significantly improves clarification, therefore reducing the effective dosage rate. Preparation of working solutions and thorough dispersal of polymers in water to be treated is also important to establish the appropriate dosage rate.

For a given water sample, there is generally an optimum dosage rate that yields the lowest residual turbidity after settling. When dosage rates below this optimum value (under-dosing) are applied, there is an insufficient quantity of coagulant to react with, and therefore destabilize, all of the turbidity present. The result is residual turbidity (after flocculation and settling) that is higher than with the optimum dose. Over-dosing, application of dosage rates greater than the optimum value, can also negatively impact performance. Again, the result is higher residual turbidity than that with the optimum dose.

D.4 Mixing in Coagulation/Flocculation:

The G-value, or "G", is a measure of the mixing intensity applied during the coagulation and flocculation processes. The symbol G stands for the "velocity gradient," which is related in part to the degree of turbulence generated during mixing. High G-values mean high turbulence, and vice versa. High G-values provide the best conditions for coagulant addition. With high G's, turbulence is high and coagulants are rapidly dispersed to their appropriate concentrations for effective destabilization of particle suspensions. Low G-values provide the best conditions for flocculation. Here, the goal is to promote formation of dense, compact floc that will settle readily. Low G provides low turbulence to promote particle collisions

so that floc can form. Low G also generates sufficient turbulence such that collisions are effective in floc formation, but does not break up floc that has already formed.

Design engineers wishing to review more detailed presentations on this subject are referred to the following textbooks.

- Fair, G., J. Geyer and D. Okun, Water and Wastewater Engineering, Wiley and Sons, NY, 1968.
- American Water Works Association, Water Quality and Treatment, McGraw-Hill, NY, 1990.
- Weber, W.J., Physiochemical Processes for Water Quality Control, Wiley and Sons, NY, 1972.

D.5 Polymer Batch Treatment Process Description:

Stormwater is collected at interception point(s) on- site and is diverted by gravity or pumping to a storage pond or other holding area. The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

The first step in the treatment sequence is to check the pH of the stormwater in the storage pond. The pH is adjusted by the application of acid or base until the stormwater in the storage pond is within the desired pH range. When used, acid is added immediately downstream of the transfer pump. Typically sodium bicarbonate (baking soda) is used as a base, although other bases may be used. When needed, base is added directly to the storage pond. The stormwater is re-circulated with the treatment pump to provide mixing in the storage pond. Initial pH adjustments should be based on daily bench tests. Further pH adjustments can be made at any point in the process. Once the stormwater is within the desired pH range, the stormwater is pumped from the storage pond to a treatment cell as polymer is added. The polymer is added upstream of the pump to facilitate rapid mixing.

After polymer addition, the water is kept in a lined treatment cell for clarification of the sediment-floc. In a batch-mode process, clarification typically takes from 30 minutes to several hours. Prior to discharge, samples are collected for analysis of pH and turbidity. If both are acceptable, the treated water is discharged.

Several configurations have been developed to discharge treated water from the treatment cell. The original configuration is a device that withdraws the treated water from just beneath the water surface using a float with adjustable struts that prevent the float from settling on the cell bottom. This reduces the possibility of picking up sediment-floc from the bottom of the pond. The struts are usually set at a minimum clearance of about 12"; that is, the float will come within 12" of the bottom of the cell. Other systems have used vertical guides or cables which constrain the float, allowing it to drift up and down with the water level. More recent designs have an H-shaped array of pipes, set on the horizontal. This scheme provides for withdrawal from 4 points rather than a single location. This configuration reduces the likelihood of sucking settled solids from the bottom. It also reduces the tendency for a vortex to form. Inlet diffusers, a long floating or fixed pipe with many small holes in it, are also an option.

Safety is a primary concern. Design should consider the hazards associated with operations, such as sampling. Facilities should be designed to reduce slip hazards and drowning. Tanks and ponds should have life rings, ladders, or steps extending from the bottom to the top.

D.6 Adjustment of the pH and Alkalinity:

The pH must be in the proper range for the polymers to be effective, which is 6.5 to 8.5 for Calgon CatFloc 2953, the most commonly used polymer. As polymers tend to lower the pH, it is important that the stormwater have sufficient buffering capacity. Buffering capacity is a function of alkalinity. Without sufficient alkalinity, the application of the polymer may lower the pH to below 6.5. A pH below 6.5 not only reduces the effectiveness of the polymer, it may create a toxic condition for aquatic organisms. Stormwater may not be discharged without readjustment of the pH to above 6.5. The target pH should be within 0.2 standard units of the receiving water pH.

Experience gained at several projects has shown that the alkalinity needs to be at least 50 mg/L to prevent a drop in pH to below 6.5 when the polymer is added. Baking soda has been used to raise both the alkalinity and the pH. Although lime is less expensive than baking soda, if over-dosed lime can raise the pH above 8.5; thus requiring a downward adjustment for the polymer to be effective. Baking soda has the advantage of not raising the pH above 8.3 regardless of the amount that is added. Experience

indicates that the amount of baking soda sufficient to raise the alkalinity to above 50 mg/L produces a pH near neutral or 7.

Alkalinity cannot be easily measured in the field. Therefore, conductivity, which can be measured directly with a hand-held probe, has been used to ascertain the buffering condition. It has been found through local experience that when the conductivity is above 100 $\mu\text{S}/\text{cm}$, the alkalinity is above 50 mg/L. This relationship may not be constant and therefore care must be taken to define the relationship for each site.

Experience has shown that the placement of concrete has a significant effect on the pH of construction stormwater. If the area of fresh exposed concrete surface is significant, the pH of the untreated stormwater may be considerably above 8.5. Concrete equipment wash water shall be controlled to prevent contact with stormwater. Acid may be added to lower the pH to the background level pH of the receiving water.

The amount of acid needed to adjust the pH to the desired level is not constant but depends upon the polymer dosage, and the pH, turbidity, and alkalinity of the untreated stormwater. The acid commonly used is sulfuric although muriatic and ascorbic acids have been used. Pelletized dry ice has also been used and reduces the safety concerns associated with handling acid.

Appendix E: Sample Construction SWPPP Checklist

Project Name: _____
 Construction SWPPP Reviewer: _____ Review Date: _____

Section I – Construction SWPPP Narrative

1. Construction Stormwater Pollution Prevention Elements

- A. Describe how each of the Construction Stormwater Pollution Prevention Elements has been addressed through the Construction SWPPP. _____

- B. Identify the type and location of BMPs used to satisfy the required element. _____

- C. Written justification identifying the reason an element is not applicable to the proposal. _____

12 Required Elements-Construction Stormwater Pollution Prevention Plan

- | | |
|-----------------------------|----------------------------------|
| 1. Mark Limits _____ | 7. Protect Inlets _____ |
| 2. Establish Access _____ | 8. Stabilize Paths/Outlets _____ |
| 3. Control Flow Rates _____ | 9. Control Pollutants _____ |
| 4. Install Controls _____ | 10. Control De-Watering _____ |
| 5. Stabilize Soils _____ | 11. Maintain BMPs _____ |
| 6. Protect Slopes _____ | 12. Manage the Project _____ |

2. Project Description

- A. Total project area _____
- B. Total proposed impervious area _____
- C. Total proposed area to be disturbed, also off-site borrow and fill areas _____
- D. Total volumes of proposed cut and fill _____

3. Existing Site Conditions

- A. Description of the existing topography _____
- B. Description of the existing vegetation _____
- C. Description of the existing drainage _____

4. Adjacent Areas

- A. Description of adjacent areas which may be affected by site disturbance
- | | |
|---------------------------|------------------------------|
| Streams/Creeks _____ | Residential Areas _____ |
| Lakes _____ | Roads _____ |
| Mitigated Wetlands _____ | Pedestrian/Trail Paths _____ |
| Floodway/Floodplain _____ | Other _____ |
- B. Description of the downstream drainage path leading from the site to the receiving body of water. (Minimum distance of 400 yards.) _____

5. Critical Areas

- A. Description of critical areas on or adjacent to the site. _____

- B. Description of special requirements for working in or near critical areas. _____

6. On-site Soils

- A. Soil name(s) _____
- B. Soil mapping unit _____
- C. Erodibility _____
- D. Settleability _____
- E. Permeability _____
- F. Depth _____
- G. Texture _____
- H. Soil Structure _____

7. Erosion Problem Areas

Description of potential erosion problems on site _____

8. Construction Phasing

- A. Construction sequence _____
- B. Construction phasing (if proposed) _____

9. Construction Schedule

- A. Provide a proposed construction schedule _____
- B. Wet Season Construction Activities
 - 1. Proposed wet season activities _____
 - 2. Proposed wet season restraints for sensitive/critical areas _____

10. Financial/Ownership Responsibilities

- A. Identify the property owner responsible for the initiation of bonds and/or other financial securities. _____
- B. Describe bonds and/or other evidence of financial responsibility for liability associated with erosion and sedimentation impacts. _____

11. Engineering Calculations (Provide Design Calculations)

- A. Sediment Ponds/Traps _____
- B. Diversions _____
- C. Waterways _____
- D. Runoff/Stormwater Detention Calculations _____

Section II - Erosion and Sediment Control Plans

1. General

- A. Vicinity Map _____
- B. City of _____ Approval Block _____
- C. Erosion and Sediment Control Notes _____

2. Site Plan

- A. Legal description of subject property _____
- B. North Arrow _____
- C. Boundaries of existing vegetation, e.g. tree lines, pasture areas, etc. _____
- D. Areas of potential erosion problems _____
- E. On-site or adjacent surface waters, critical areas and associated buffers _____
- F. FEMA base flood boundaries and other related boundaries _____
- G. Existing and proposed contours _____
- H. Drainage basins and direction of flow for individual drainage areas _____

- I. Final contours and identify developed condition drainage basins _____
- J. Delineate areas that are to be cleared and graded _____
- K. Show all cut and fill slopes indicating top and bottom of slope catch lines _____

3. Conveyance Systems

- A. Locations for swales, interceptor trenches, or ditches _____
- B. All temporary and permanent pipes, ditches, or cut-offs required for ESC _____
- C. Minimum slope and cover for all pipes or pipe inverts _____
- D. Grades, dimensions, and direction of flow _____
- E. Details for bypassing off-site runoff around disturbed areas _____
- F. Locations and outlets of dewatering systems _____

4. Location of Detention BMPs

5. Erosion and Sediment Control Facilities

- Locations of sediment traps, ponds, pipes and structures _____
- Dimension pond berm widths and slopes _____
- Trap/pond storage required and the depth, length, & width dimensions _____
- Typical section views through pond and outlet structure _____
- Typical details of gravel cone and standpipe, and/or other filters _____
- Stabilization techniques for outlet/inlet _____
- Control/restrictor device location and details _____
- Specify cover of berms and slopes _____
- Rock specifications and detail for rock check dams; Specify spacing _____
- Front and side sections of typical rock check dams _____
- Locations and details and specifications for silt fabric _____
- Construction entrance location and detail _____

6. Detailed Drawings

Any practices used that are not referenced by city code or regulation should be explained and illustrated with detailed drawings. _____

7. Other Pollutant BMPs

Indicate on the site plan the location of BMPs to be used for the control of pollutants other than sediment, e.g. concrete wash water. _____

8. Monitoring Locations

Indicate on the site plan the water quality sampling locations to be used for monitoring water quality on the construction site, if applicable. _____

Appendix F: Minimum Requirements for Training Course

F.1 General Requirements

F.2 Required Course Elements

F.3 Instructor Qualifications

F.1 General Requirements

1. The course shall teach the construction stormwater pollution prevention guidance provided in the most recent version of:
 - A. CPESC, CESSWI, CSI or other Stormwater Erosion and Sediment Control certified courses, or
 - B. Other equivalent stormwater management manuals approved by the state.
2. Upon completion of course, each attendee shall receive documentation of training that states completion of the course.
3. The initial training course shall be a minimum of 6 hours (with a reasonable time allowance for lunch and breaks) and include field elements (may be by photo or video). The field elements must familiarize students with the proper installation, maintenance and inspection of common erosion and sediment control BMPs including, but not limited to: blankets, check dams, silt fence, straw mulch, plastic, and seeding.
4. The refresher course shall be a minimum of 4 hours.
 - A. The refresher course shall include:
 - Applicable updates to the Stormwater Management Manual that is used to teach the course, including new or updated BMPs; **AND**
 - Applicable changes to the NPDES General Permit for Construction Activities.
 - B. The refresher course may be taught using an alternative format (e.g. internet, CD ROM, etc.) if the module is approved by State.

F.2 Required Course Elements

1. Erosion and Sedimentation Impacts
 - Examples and case studies
2. Erosion and Sedimentation Processes
 - A. Definitions
 - B. Types of erosion
 - C. Sedimentation
 - Basic settling concepts
 - Problems with clays/turbidity
3. Factors Influencing Erosion Potential
 - A. Soil
 - B. Vegetation
 - C. Topography
 - D. Climate
4. Regulatory Requirements
 - A. NPDES - Construction Stormwater General Permit
 - B. Local requirements and permits
 - C. Other regulatory requirements
5. Stormwater Pollution Prevention Plan (SWPPP)
 - A. SWPPP is a living document – should be revised as necessary
 - B. 12 Elements of a SWPPP; discuss suggested BMPs (with examples)

<ul style="list-style-type: none"> • Mark Clearing Limits • Establish Construction Access • Control Flow Rates • Install Sediment Controls 	<ul style="list-style-type: none"> • Stabilize Soils • Protect Slopes • Protect Drain Inlets • Stabilize Channels and Outlets 	<ul style="list-style-type: none"> • Control Pollutants • Control De-watering • Maintain BMPs • Manage the Project
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6. Monitoring, Reporting, & Record-keeping
 - A. Site inspections/visual monitoring
 - Disturbed areas
 - BMPs
 - Stormwater discharge points
 - B. Water quality sampling & analysis
 - Turbidity
 - pH
 - C. Monitoring frequency
 - Set by NPDES permit
 - Inactive sites - reduced frequency
 - D. Adaptive Management
 - When problem is indicated, take appropriate action (e.g. install/maintain BMPs)
 - Document the corrective action(s) in SWPPP
 - E. Reporting
 - Inspection reports & checklists
 - Non-compliance notification
 - Discharge Monitoring Reports (DMR)

F.3 Instructor Qualifications

1. Instructors must be qualified to effectively teach the required course elements.
2. At a minimum, instructors must have:
 - A. Current certification as a Certified Professional in Erosion and Sediment Control (CPESC), Certified Erosion, Sediment, and Storm Water Inspector (CESSWI), Certified Professional in Storm Water Quality (CPSWQ), or Certified MS4 Specialist (CMS4S); **OR**
 - B. Completed a training program for teaching the required course elements, **OR**
 - C. The academic credentials and instructional experience necessary for teaching the required course elements.
3. Instructors must demonstrate competent instructional skills and knowledge of the applicable subject matter.